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Title of Project: The Effect of Health Information Technology on Healthcare Provider Communication

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Organization: The University of Michigan

Inclusive Dates of Project: 09/01/2014 – 04/29/2019

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STRUCTURED ABSTRACT

Purpose: The purpose of this study was to describe how communication technologies facilitate or hinder communication between nurses and physicians with the ultimate goal of identifying optimal ways to support effective communication.

Scope: Communication failures between physicians and nurses are one of the most common causes of adverse events for hospitalized patients and a root cause of all sentinel events. Communication technologies (i.e., the electronic medical record, computerized provider order entry, email, and pagers) may help reduce some communication failures but increase others; to determine why this occurs we need to understand how technology is used for communication purposes.

Methods: Participants included physicians and nurses from medical-surgical units in hospitals. A quantitative survey identified the range of communication technologies in a national sample of hospitals; these results were used to identify 8 hospitals with variation in technology use and communication practices for follow-up telephone interviews to understand communication practices and work relationships. We then spent two weeks on a medical-surgical unit in four of these eight hospitals, conducting observation, clinician shadowing, and focus groups to learn how communication technologies, communication practices, and work relationships affect communication between physicians and nurses. We inductively coded and thematically analyzed the entire data set.

Results: Relationships and familiarity of nurses and physicians with one another determined technology use regardless of the technology available. Physician and nurse expectations and preferences for communication methods did not match; nurses sometimes manipulated communication to get certain responses; and lack of trust in and responsiveness of physicians could, at times, pose a risk to patient safety.

Key Words: interdisciplinary communication, communication technology, interdisciplinary relationships, patient safety

Purpose

The purpose of this study was to describe how communication technologies facilitate or hinder communication between nurses and physicians with the ultimate goal of identifying optimal ways to support effective communication. There were three specific aims: **(1)** identify the range of communication technologies used in a national sample of medical-surgical acute care units; **(2)** describe communication practices and work relationships that may be influenced by communication technologies in these same settings; and **(3)** explore how differences in communication technologies, communication practices, and work relationships between physicians and nurses influence communication.

Scope

Background

It is already clear that information and communication technology (ICT) deployed in hospitals are accompanied by risks to patients.[1] For example, poor communication between physicians and nurses is one of the most common causes of adverse events for hospitalized patients[2–4] and a major root cause of all sentinel events.[5] Health information technology (HIT) offers potential solutions including a variety of media that physicians and nurses now use in communicating with each other: the electronic health record, computerized provider order entry, email, and pagers. Increasing use of ICT is likely to affect communication between nurses and physicians, and since there is already evidence that communication technologies can contribute to more[6,3] not fewer[7] communication difficulties, it is critically important to better understand how communication technology is used in healthcare.[6]

Context

We focused our study on medical-surgical units which are among the least specialized units in hospitals, and the lack of specialization affects communication practices. Greater unit specialization makes it easier to share understanding of a narrow body of knowledge, the specialty, fostering common

ground between communicators. Very few research teams have addressed the challenges associated with communication between physicians and nurses outside of specialty units, despite the adverse consequences for patients when communication is poor. Medical-surgical units house the majority of hospitalized patients and include many of AHRQ's priority populations: women, the elderly, those with chronic conditions, and low income and minority groups. Through the development of communication science in healthcare, studies such as ours have the potential to significantly influence the well-being of those patients.

Setting

The setting varied by Aim. The survey in Aim 1 was distributed to chief nurse executives in all 105 hospitals that were members of the National Nursing Practice Network (NNPN), a consortium of hospitals nation-wide dedicated to evidence-based nursing practice. From the 74 hospitals that completed the survey, we selected 8 for telephone interviews to meet Aim 2. These hospitals included academic medical centers, small and large community hospitals, and two hospitals from the Department of Veterans Affairs (VA). We deliberately chose two VA hospitals because the VA is the largest integrated health system in the country and has the most mature electronic health record system. Four of these 8 hospitals were selected for in depth qualitative exploration to meet Aim 3 in which we spent two weeks at a time on a medical-surgical unit at each hospital. One hospital was an academic medical center in Kentucky, one was a VA hospital affiliated with a medical center in Iowa, and the other two hospitals were community hospitals, one in Iowa and the other in Michigan.

Participants

In Aim 1, the survey was completed by the chief nurse executive or delegate. As the survey was anonymous, we have no way of knowing who actually completed the survey. Seventeen registered nurses and 2 physicians participated in the telephone interviews in Aim 2. In Aim 3, a total of 163 physicians, nurses, and nurse practitioners participated in shadowing, focus groups, and interviews.

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<u>Incidence and Prevalence</u>

Health information technology enhances but also can disrupt standard modes of communication.[8] Each type of technology may alter communication in a different way. Even changing from one electronic form of communication to another can cause unintended consequences such as in one case, a 233% increase in pages physicians received, causing interruptions and possibly impacting patient safety.[9] Some electronic health record (EHR) features may detract from rather than enhance communication. For example, "copy and paste" functions allow for more rapid input but diminish the exchange of information, and make the text less useful for understanding the patient's status. The computerized provider order entry (CPOE) function in the EHR has been found to generate new kinds of errors because users do not navigate through all of the serial interface screens to enter data in the correct spot.[10] Finally, paging systems have changed with the advent of web-based text paging that allows the display of alphanumeric characters as well as numbers. Established communication practices can change when organizations move from a paper-based to electronic patient record keeping system[11] because the content and patterns of communication are altered.[6] Structuring communication exchanges in electronic format can also create ambiguity and reduce flexibility,[6] with the result that in using sophisticated communication technologies physicians and nurses may lose sight of the fact that a message is a symbolic attempt to convey meaning.[12] However, the impact of these changes on communication practices remains an underexplored area.

Methods

<u>Study Design</u>

This study used a mixed methods design. Results from a quantitative survey in Aim 1 were used to inform subsequent qualitative phases in Aims 2 and 3.

<u>Data Collection</u>

For Aim 1, we recruited Chief Nurse Executives from all 105 hospitals participating in the NNPN via an invitation letter sent in the mail. A twenty-dollar gift card was included in the letter, which included a hyper link to the online survey that was available in REDCap, an online, HIPAA compliant, and secure web-based survey platform.

The selection of survey questions was guided by our theoretical framework to identify the variety of communication media (including communication technologies) that may interfere or assist with physician-nurse communication in each hospital. Where existing instruments included questions of interest, we incorporated them into our survey (e.g., questions on EHR adoption came from the American Hospital Association (AHA) IT Supplement). For questions on availability and use of other types of technologies (e.g., pagers, cell phones, tablets), as well as questions on computer-mediated communication between physicians and nurses, we did not find suitable questions from existing instruments and therefore developed new ones. The survey consisted of 99 total questions and was divided into seven sections: overall HIT adoption, computer hardware, physician and nurse use of computers, infrastructure for electronic communication (i.e., pagers and electronic white boards), nurse and physician use of electronic communication technologies, non-electronic ways of communicating, and demographics. Questions included both availability of technology and extent of use.

We created four indices by grouping the questions into four categories: hardware, software, telephony, and non-technological communication practices. Components of each index are described in Table 1 above. We classified the first three categories (hardware,

Table 1. Index types and their components

Index Type	Items included in each index
Communication related hardware	Stationary, portable, and tablet computers
Software that facilitates communication	Email within EHR, email separate from EHR, middleware, CPOE
Telephony	RN assignment to individual phones, RN and MD use of cellular phones, RN and MD use of pagers
Non-HIT mediated communication	Face-to-face communication, use of verbal orders, contact w/ MD extender, RN participation in patient care rounds

software, telephony) as technology indices. We scored responses to each question from 0 to 1, with 1 indicating more of whatever was being measured. We scored individual question responses in line with the perceived value of the adoption of that particular technology or communication practice. For example, for level of EHR adoption, a basic EHR without clinician notes was scored as a 0.0, a basic EHR with clinician notes was scored as 0.5, and a comprehensive EHR was scored as a 1.0.

For Aim 2, we then identified two hospitals in each combination (e.g., high technology score, high non-technological communication practices; high technology score, low non-technological communication practices; etc.) and contacted the chief nurse executive by telephone for recruitment. We selected a variety of hospital types and included two VA hospitals as well. All 8 of the hospitals we initially contacted agreed to participate. Four of the 8 hospitals were then chosen, based on variation in technology, organizational size and academic affiliation, to participate in Aim 3.

Aim 1 survey data were collected by being directly entered into the online REDCap system. Data for Aim 2 were collected via telephone interviews, which were audio-recorded and transcribed verbatim. Aim 3 data were collected via hand-written notes taken during observation and shadowing, and focus group and interview transcripts generated from audio-recorded sessions.

Interventions and Measures

As this was a descriptive study, we have no interventions to report. Our quantitative survey, developed specifically for this study, has been added to AHRQ's compendium of surveys and is available online.

Limitations

Our descriptive, cross-sectional study cannot make any statements about causal relationships, as we did not explore relationships over time. The hospitals that participated in the study may bear little similarity to other hospitals in the country because NNPN hospitals are dedicated to evidence-based nursing practice. Our results may not be generalizable to other hospitals or unit types. We did not

include the perspective of patients or other healthcare providers (e.g., respiratory therapists, pharmacists) who contributed to communication exchanges, artificially narrowing communication practices and use of technology to nurses and physicians, to maintain emphasis on the purpose of our study.

Results

<u>Principal Findings</u>

For Aim 1 (identify the range of communication technologies used in medical-surgical acute care units) 74 hospitals provided complete data for analysis (70% response rate). All of the hospitals reported using EHRs. There were positive associations between hardware and software, and also among software, telephony, and non-technology mediated communication. Interestingly, hospitals that reported having more technology-related communication tools also reported more non-technology mediated communication, suggesting that technology may introduce confusion that needs to be resolved with face-to-face conversations. Not surprisingly, we found that different types of communication technology tools were used for different types of communication (e.g., an "FYI" message from nurse to physician was typically sent via pager, instead of face-to-face). Finally, the presence of an EHR was insufficient for understanding adoption of health information technology, because how computers were being used for communication purposes was more important than the number or type.

The purpose of Aim 2 was to describe communication practices and work relationships between physicians and nurses that may be influenced by communication technologies in these same settings. We conducted 19 interviews in Aim 2, only 2 of which were with physicians, so preliminary themes were heavily weighted towards the nurse perspective and thus not helpful in understanding the physician perspective on how communication practices and work relationships were influenced by communication technologies. However, one of the objectives of Aim 2 was to help us select 4 hospitals for in depth

qualitative exploration in Aim 3. Interviews conducted during Aim 2 were a stepping stone, helping us build rapport with clinicians at each site and gain entrée for Aim 3.

The purpose of Aim 3 was to explore how differences in communication technologies, communication practices, and work relationships between physicians and nurses influence communication. In Aim 3 we spent 2 weeks at each hospital conducting observation, shadowing, focus groups, and interviews. The participants totaled 110 nurses, 8 nurse practitioners, and 45 physicians, as identified in Table 2 (Site A – Community hospital in Michigan; Site B – Community hospital in Iowa; Site C – Academically affiliated VA hospital in Iowa; Site D – Academic medical center in Kentucky).

Table 2. Participants by Site

	Site A	Site B	Site C	Site D	Total
RN Shadowing	7	7	4	6	24
RN Interview/ FG Participants	24	11	18	33	86
MD Shadowing	3	0	4	6	13
MD Interview Participants	3	5	14	10	32
Total participants	37	23	40	55	155

We collected vast amounts of data that were analyzed, with numerous results but in this report we present our principal findings, because other results emanated from one of these four: (1) work relationships and familiarity among nurses and physicians affected communication quality, the medium used for communication, and communication frequency more so than any communication technology that was available; (2) physician and nurse expectations and preferences for communication methods did not match, despite efforts to share and understand those expectations and preferences, in part because of rotating and constantly changing teams of physicians; (3) nurses manipulated communication to get certain responses or avoid particular types of contact based on their expectations of behavior and relationships; and (4) nurses provided many examples of patient safety concerns, stemming from lack of trust and responsiveness of physicians.

<u>Outcomes</u>

Some of our results confirmed findings from other research reporting that communication technology does not always facilitate communication,[13] its convenience is offset by documentation and information retrieval barriers,[8] and standardization (in the form of templates) has both negative as well as positive effects on communication.[14] The new findings in our study are related to the association that we found between work relationships and technology. No matter what technology was available or in use, physicians and nurses sought each other out for face-to-face conversations when relationships were good, and tended to use technologies such as pagers and texting to avoid each other when relationships were poor. This association contributed to the manipulation of communication such that nurses purposefully avoided certain types of contact with physicians, which in turn led to asynchronous communication practices and uneven information exchange, with implications for patient safety.

<u>Discussion</u>

By the time our study started in 2014, the use of electronic health records and communication technologies was ubiquitous across the 105 hospitals nationally that made up our sampling frame. Results from the survey conducted in Aim 1 provided a snap-shot of the various types of hardware, software, telephony, and non-technological ways of communicating that were used by these hospitals. Telephone interviews conducted as part of Aim 2 provided broad hints as to how the technologies were used for communication but it wasn't until we were embedded in medical-surgical units in four hospitals during Aim 3 that we fully understood not only how the technologies were used, but also why, and the implications of their use.

Importantly, communication technology tools did not decrease the need for face-to-face communication, raising the question of the value of technology for communication purposes. For example, both groups (physicians and nurses) had similar complaints about technology, but not always for the same reasons. Both groups found information retrieval from the EHR difficult and time-

consuming. Physicians tried to save time by using the copy/paste function to update progress notes and write orders, but the nurses found no new information in copy/pasted progress notes and complained that many orders were the same and "too vanilla." The same communication technologies were not available to both groups of clinicians. Nurses did not have access to the same technological devices as physicians and this contributed to uneven communication exchanges and uncertainty about whether or not a specific message had been received.

We found that patients played an indirect role in communication between physicians and nurses. For example, sometimes nurses would hear information from patients that would need to be confirmed with the physician, possibly interrupting the physician in some other task. As interruptions can contribute to lapses in patient safety by adding to clinicians' cognitive burden, including patients in future studies may help to determine if interruptions can be decreased.

There are many reasons why communication between physicians and nurses is fraught and has been the source of adverse patient events for more than 50 years. Two of the most common reasons cited in the literature are that first, physicians and nurses, representing separate disciplines, are trained in different paradigms and these differences account for some of the barriers to communication.[12] For example, nurses tend to use indirect language rather than coming quickly to the point during a communication exchange, causing frustration for physicians. Second, the two groups also represent different social strata in the hospital hierarchy and the higher social status of physicians often constrains nurses from "speaking up" when there is a patient situation that demands attention.[15]

Related to this, we found that by not having access to the same technologies, communication practices are uneven and choices become limited in what technology is used and how (e.g., when nurses do not have personal telephones physicians call a shared phone or nursing station phone, often taking more time but resulting in a less satisfactory communication exchange). Such uneven access to technology put additional barriers on communication practices with the result that communication

technologies have not been able to overcome differences in distribution and thus do not facilitate communication.

Conclusions

There are three main conclusions from our study: (1) communication technologies and the ways in which they are being used are still contributing to communication challenges between physicians and nurses; (2) clinicians continue to use communication technologies that do not facilitate communication, especially when work relationships are poor; and (3) in addition to ongoing access to asynchronous communication devices such as pagers, nurses and physicians should have equal access to synchronous communication devices to facilitate the dialogue that we maintain is necessary for communication to be effective.

Significance and Implications

Advances in communication technologies have often come without a full understanding of how they support or inhibit communication practices of busy clinicians in hospital settings, and our study is significant because it has contributed to developing a fuller understanding of the relationship between communication technologies and communication practices. Our finding that these technologies actually increased rather than replaced face-to-face communication is significant because it suggests that ongoing confusion between clinicians when using communication technologies required face-to-face conversations for resolution. Also, we have more to learn about optimizing communication technologies, perhaps using non-technological strategies. For example, the location of computers used to access the electronic systems can sometimes allow people to evade face-to-face contact, even as there may be more need for it, as indicated by what happened at better functioning sites where providers had better relationships. It may be important to reconsider the location of computer terminals as a way to create more opportunities for face-to-face conversations.

Our finding that work relationships are a critical determinant of the type and frequency of technology in use is also significant and suggests that without paying more attention to how to improve those relationships, ongoing challenges to communication will continue, despite advancements in communication technologies. It may also be important to revisit some of the virtues of physician co-location, inter-disciplinary rounding and other relationship-building activities that encourage face-to-face contact so as to counteract the balkanization that the EHR and more advanced texting and paging systems can induce.

Our study uncovered some consequences when nurses and physicians did not have access to the same communication technologies. Uneven access contributed to one-way asynchronous flow of information and uncertain information exchange. One-way asynchronous information flow does not allow synchronous back-and-forth dialogue that is crucial to developing the shared understanding that is at the heart of effective communication.[16] As a result of one-way information flow it was impossible for the information sender to confirm if the information had been received, read, or reviewed. We heard of many instances where physicians did not respond to messages sent by nurses because they were overwhelmed, did not think that the message was worthy of a response, or were unable to determine who the message came from. Without confirmation, there was the potential for information to "fall through the cracks" and possibly jeopardize patient safety.

Our study has several implications for clinical practice and policy makers. Improving work relationships may lead to more appropriate use of communication technologies, and may obviate the need for expenditures on sophisticated technologies that do not reduce communication challenges between clinicians. Introducing or more widely supporting technology that allows synchronous information exchange would help reduce confusion when information flows in one direction only because when using asynchronous technologies there is no opportunity to seek and receive immediate clarification. Requiring that all clinicians have access to the same technology would be an important step

towards achieving "interoperability" between clinicians. While interoperability is a concept usually reserved for computer systems, software, or devices, applying the principle to people would send the message that since all clinicians make worthwhile contributions to patient care, they are all deserve to have access to the same technology to do their work, so that they can better understand each other.

List of Publications and Products

1. Manojlovich, M., Adler-Milstein, J., Harrod, M., Sales, A., Hofer, T.P., Saint, S., Krein, S.L. (2015). The Effect of Health Information Technology on Health Care Provider Communication: A Mixed-Method Protocol. *Journal of Medical Internet Research: Research Protocols, 4*(2):e72. URL: http://www.researchprotocols.org/2015/2/e72/doi:10.2196/resprot.4463.

2. Holmgren, A.J., Pfeifer, E., Manojlovich, M., Adler-Milstein, J. (2016). A novel national survey examining the relationship of hospital characteristics and Health IT adoption to nurse-physician communication. *Applied Clinical Informatics, 7*(4), 1182-1201. PMID: 27999841

3. Umberfield, E., Ghaferi, A., Krein, S.L., **Manojlovich, M.** (2019). Using incident reports to assess communication failures and patient outcomes. *The Joint Commission Journal on Quality and Patient Safety, 45,* 406 - 413. doi: doi.org/10.1016/j.jcjq.2019.02.006 [grant funding used to support effort]

Papers in review

3. Lafferty, M., Krein, S., Harrod, M., McBratnie, M., and Manojlovich, M. (in review). Challenges of One-Way Communication Technologies in Healthcare: A Qualitative Study of Physician-Nurse Paging Practices.

4. Manojlovich, M., Harrod, M., Hofer, T., Lafferty, M., McBratnie, M., Krein, S. (in review). Patient care rounds as a conduit for interpersonal communication

Papers in Preparation

1. Lafferty, M., Krein, S., Harrod, M., Manojlovich, M. Choosing Mediums, Manipulating Messages: Relationships and Interprofessional Communication Practices.

2. Manojlovich, M., Harrod, M., Hofer, T., Lafferty, M., Krein, S. Factors influencing physician responsiveness to nurse-initiated communication.

3. Lafferty, M., Krein, S., Harrod, M., Manojlovich, M. Spaces of (Missed) Communication: Influences of Hospital Unit Layout on Interprofessional Coordination. (to be submitted to *HERD*)

Refereed paper presentations

2016   "Examining the Relationship between Health Information Technology Adoption and Communication between Nurses and Physicians." Presented at the American Academy on Communication in Healthcare Annual meeting, New Haven, CT. 06/17/16.

2017   "Challenges and Opportunities Surrounding HIT: Hospital Clinicians Share their Stories." Manojlovich, M., Adler-Milstein, J., Hofer, T.P., Krein, S., Sales, A., and Harrod, M. Presented at the Interdisciplinary Research Group for Nursing Issues, before the start of AcademyHealth. 6/24/17.

2019   "Effects of Hospital Layout and Nursing Unit Design on Nurse-Physician Communication and Nursing Team Collaboration." Lafferty, M., Harrod, M., Krein, S., Manojlovich, M. Presented at Academy Health, Washington, DC. June 1, 2019.

2019   "Using multiple qualitative methods to understand use of communication technology and communication practices between physicians and nurses in inpatient general care units." Manojlovich, M., Harrod, M., Hofer, T., Lafferty, M., Krein, S. Presented at Academy Health, Washington, DC. June 4, 2019.

Refereed poster presentations

1. Manojlovich, M., Harrod, M., Krein, S.L., Sales, A., Adler-Milstein, J., Hofer, T., Saint, S. "Examining the Relationship between Health Information Technology Adoption and Communication between Nurses and Physicians." Poster presented at AcademyHealth Research Meeting in Boston, MA. June 26, 2016.

2. Lafferty, M., Krein, S., Harrod, M., Hofer., T., Manojlovich, M. "Challenges of One-Way Communication Technologies in Healthcare: A Qualitative Study of Physician-Nurse Communication Practices on Medical-Surgical Units." Poster presented at AcademyHealth, Seattle, WA. June 23, 2018.

3. Lafferty, M., Harrod, M., Krein, S., Manojlovich, M. "Choosing mediums, manipulating messages: relationships and physician-nurse communication practices." Poster presented at the International Conference on Communication in Healthcare in Porto, Portugal, September 2018.

4. Manojlovich, M., Harrod, M., Hofer, T., Lafferty, M., Krein, S. "Patient Care Rounds as a Conduit for Interpersonal Communication." Poster presented at the Human Factors Engineering Symposium in Healthcare, Chicago, IL, March 25, 2019.

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Other Products

Our survey has been added to AHRQ's compendium of instruments.

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